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GB 1081748 A US 4298589 A

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(54) Abstract Title
Arrangement of a retaining grille of an active material in a vessel, and a vessel so equipped

(57) The invention relates to a grille (112) for retaining an active material (116) in a vessel (102) which has a convex bottom delimiting an internal space of the vessel. The grille (112) is vault-shaped and is arranged in said internal space in contact over part of its periphery with the inside wall of the convex bottom of the vessel, the convexity directions of the vault (112) and bottom being opposite.

Applications for the supporting grilles of an adsorbent material in an adsorber.

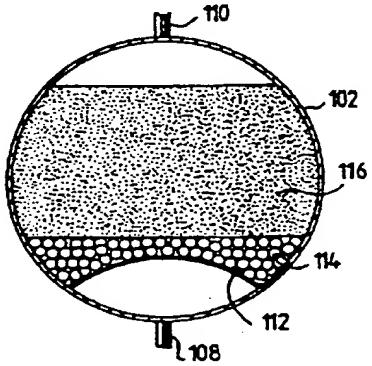

FIG. 13

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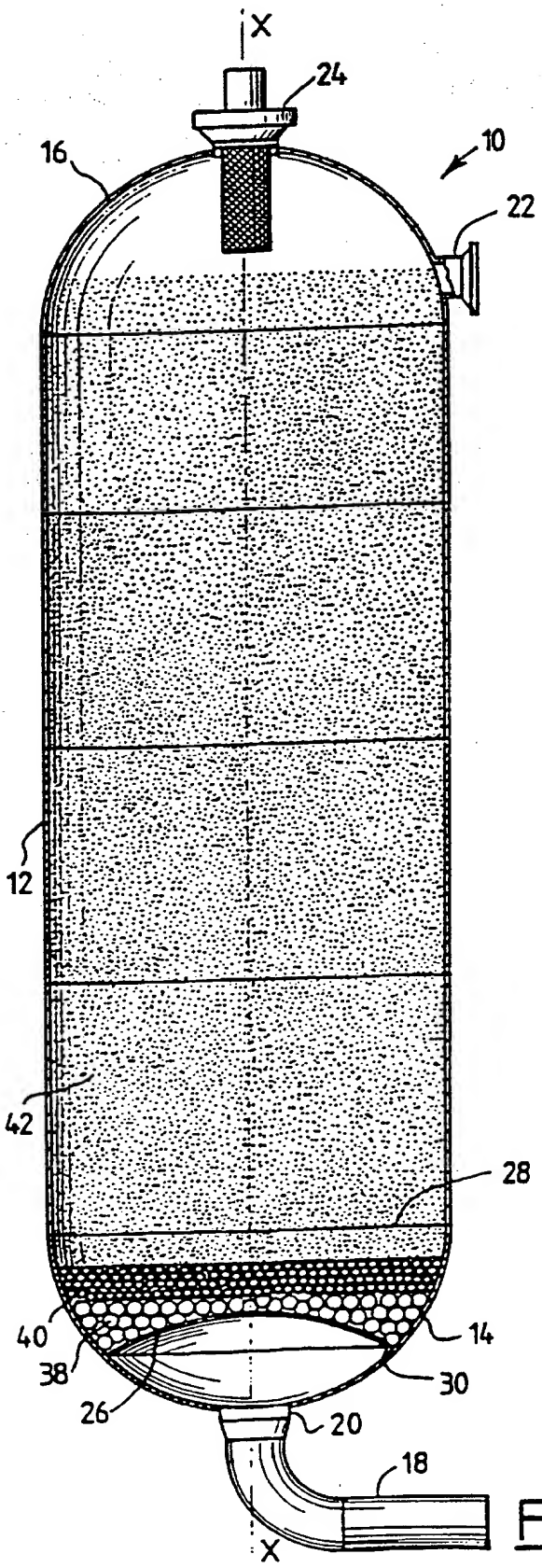

FIG. 1

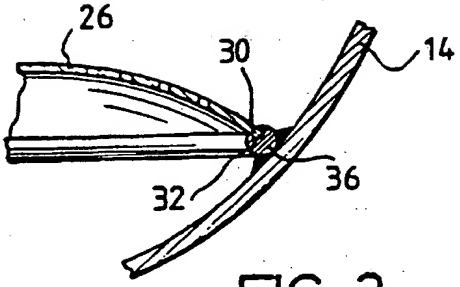

FIG. 3

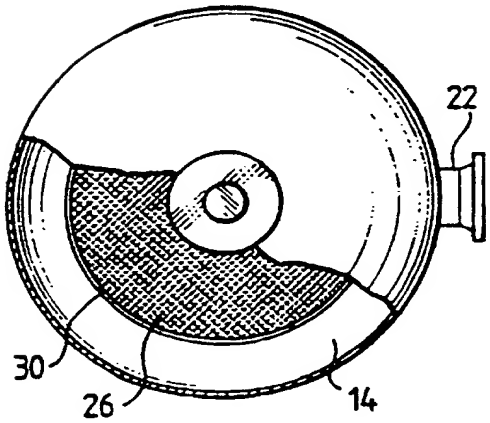

FIG. 2

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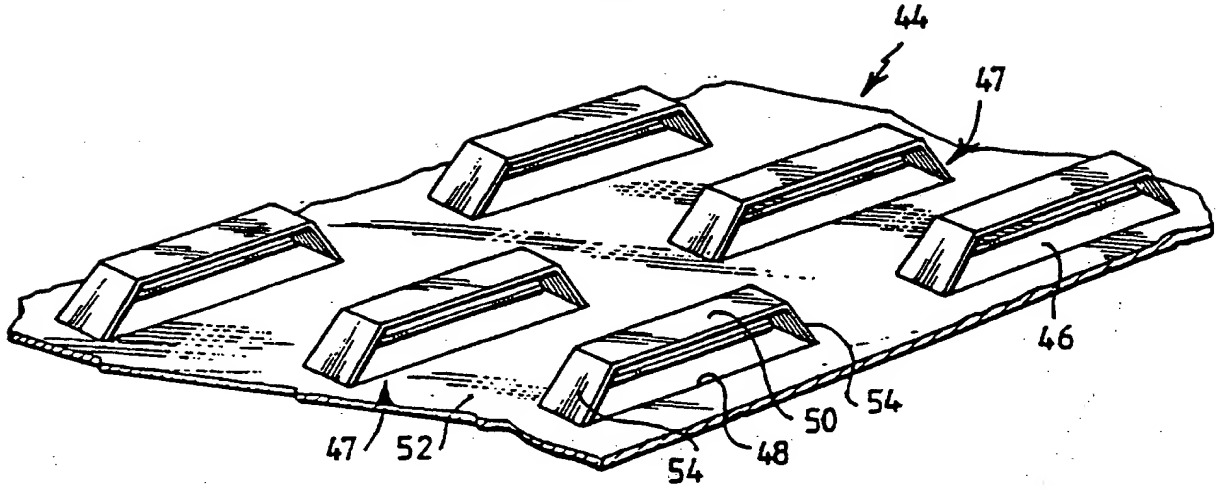

FIG. 4

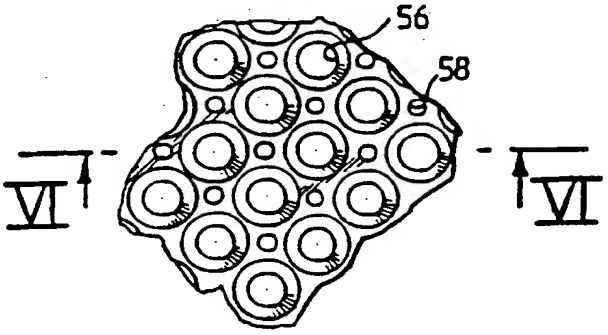

FIG. 5

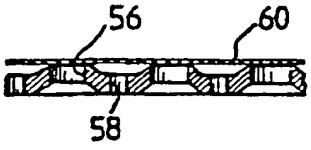

FIG. 6

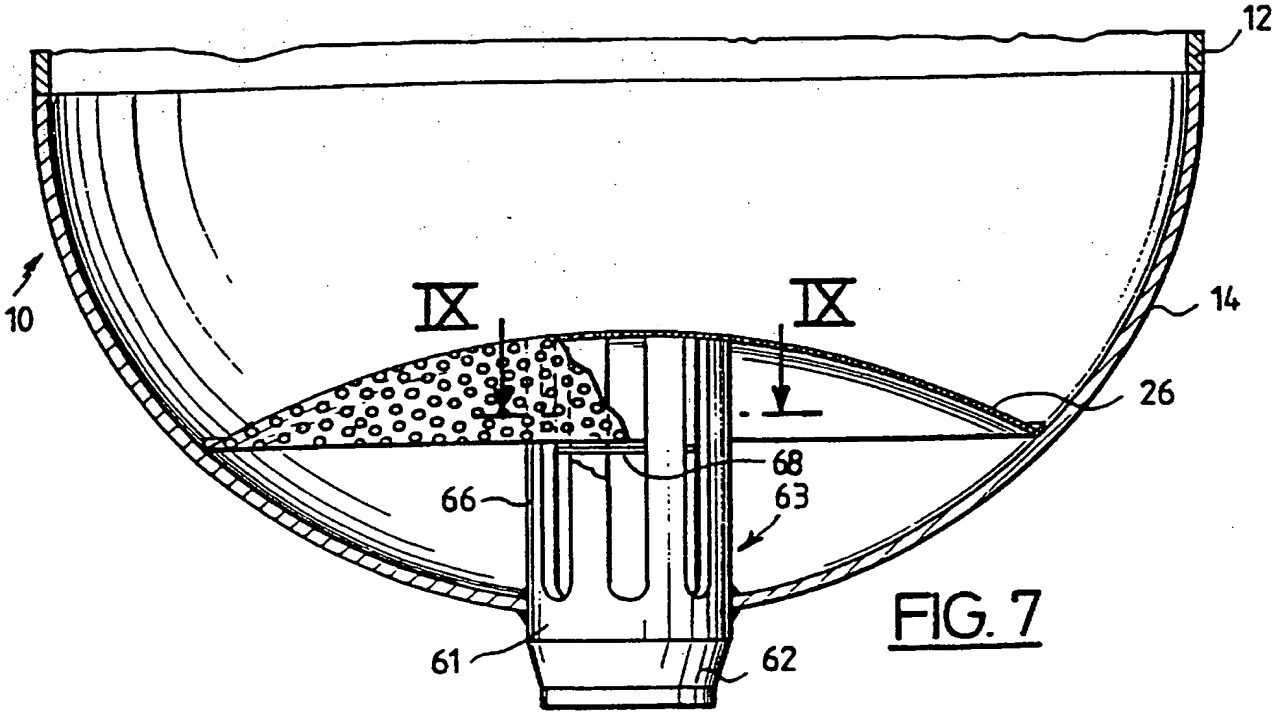

FIG. 7

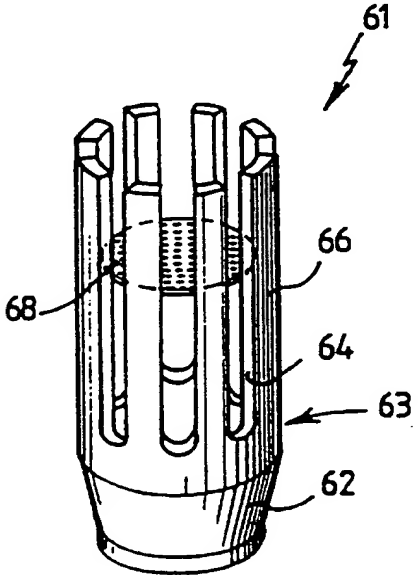

FIG. 8

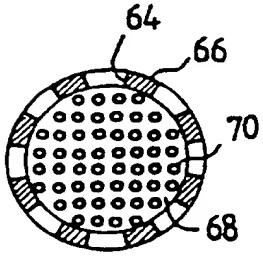

FIG. 9

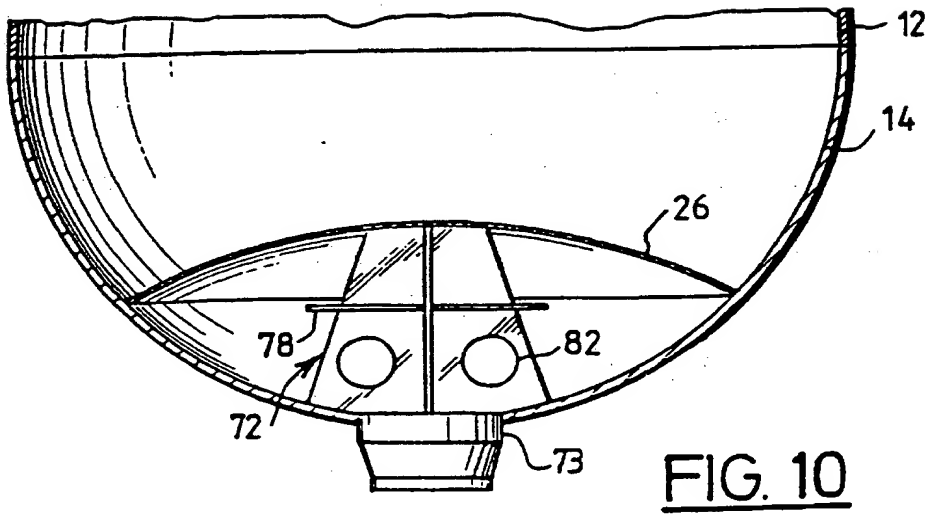

FIG. 10

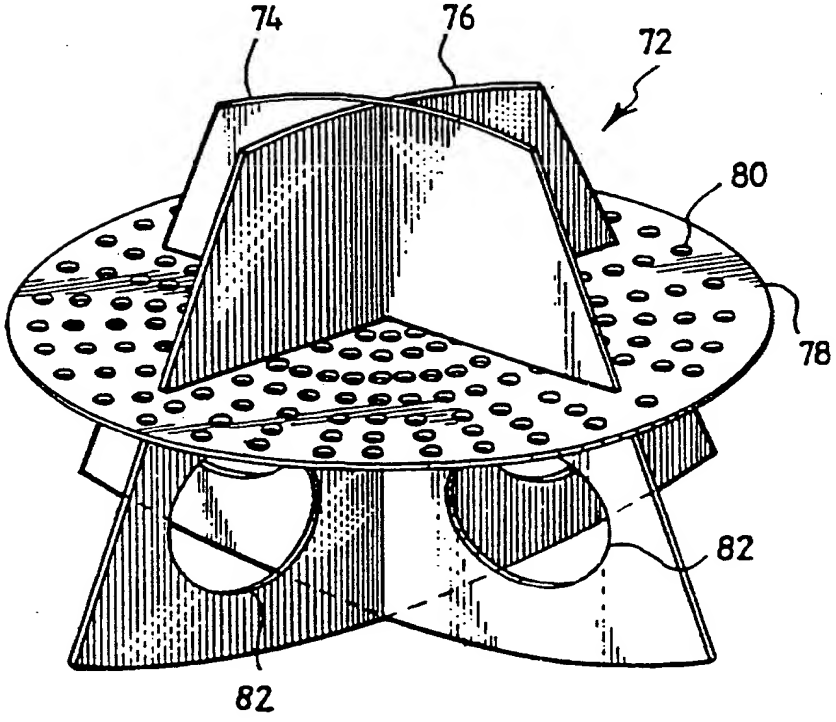

FIG. 11

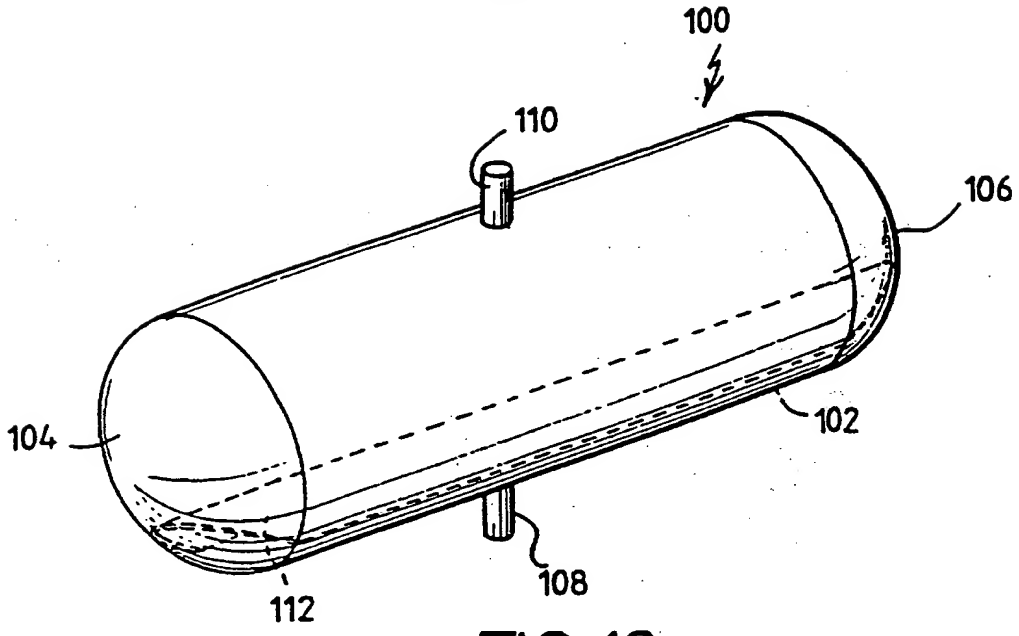

FIG. 12

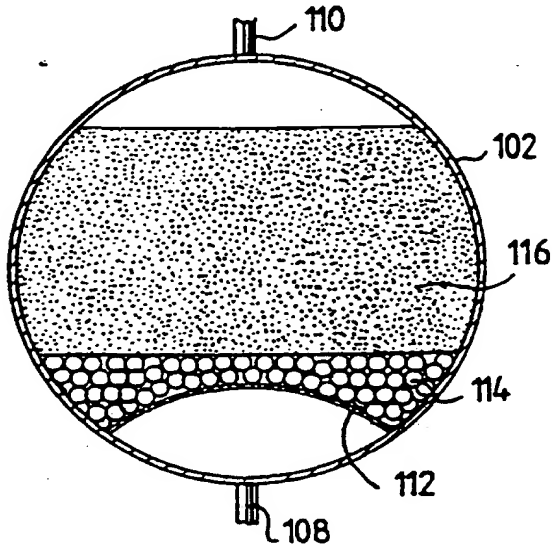

FIG. 13

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ARRANGEMENT OF A RETAINING GRILLE OF AN ACTIVE MATERIAL IN A VESSEL, AND A VESSEL SO EQUIPPED

The present invention relates to an arrangement of a grille for retaining an active material in a vessel having a convex portion delimiting an internal space of the vessel, in particular a convex bottom.

In industrial installations, especially installations for purification by adsorption and installations for the treatment of gas or petroleum products, use is commonly made of vessels or even reactors containing an active material, formed for example by a catalyst or by beads of an adsorbent material.

This active material inside the vessels is maintained, retained and/or supported by grilles, arranged in particular above perforations for the infeed or evacuation of fluids.

For vessels in which the perforation, the infeed for example, discharges into a convex portion of the vessel, for example a hemispherical bottom, the current method consists in arranging a flat grille over the bottom, forming a support for the active material arranged in the vessel. The term "convex portion" means a portion of the vessel with decreasing dimensions, delimited by a rounded surface projecting outwards.

Conventionally, this flat grille is formed by a collection of gratings resting on a supporting structure arranged in the hemispherical portion forming the bottom. This supporting structure is generally formed by radial ribs, welded to the inside wall of the bottom, thus constituting a complete bottom grid.

The weight of material which has to be supported and the major losses of charge, arising from the circulation of fluid in the vessel, subject the grille to great stresses. For this reason, the supporting structure has to have a great mechanical strength.

Moreover, in order to ensure a good distribution of gas within the active material, the grille is arranged in the bottom portion having the largest cross-section, i.e. at the level of the equator in the case of a hemisphere. The entire volume of the hemisphere is then utilised to permit a good distribution of the fluid. This volume of

the vessel constitutes a dead volume in respect of the utilisation of the vessel, since it contains no active material, thereby requiring the design of vessels with a relatively large volume.

Moreover, in order further to improve the gas distribution in the active materials, it is possible to interpose a layer of diffusing material, for example ceramic beads, between the active material and the grille. This additional layer further reduces the volume available for the active material.

Thus, the retaining grilles for active material currently in use in vessels have a relatively high cost of implementation, since they require a solid and complex supporting structure, which in addition reduces the volume available for the active material in the vessel.

The aim of the invention is to provide a retaining grille for active material, arranged in such a way as to reduce its cost of manufacture and implementation in a convex portion of the vessel, and which in addition permits an increase in the volume available for the active material, thereby reducing the total volume of the vessel for an equivalent performance of same.

To this end, the subject-matter of the invention is an arrangement of a grille for retaining an active material in a vessel comprising a convex portion which delimits an internal space of the vessel, particularly a convex bottom, characterised in that the grille is vault-shaped and is arranged in said internal space, in contact over at least part of its periphery with the inside wall of the convex bottom of the vessel, the convexity directions of the vault and of the bottom being opposite.

According to particular embodiments, the invention can have one or more of the following characteristics:

- the convex bottom has a perforation for the inlet/outlet of fluid, said grille being interposed between this perforation and said active material;

- the perforation is fitted with a deflector arranged at least partially in the space delimited by the grille and the convex bottom, the deflector forming a support for the grille;

- the convex bottom is delimited by a surface of revolution, and the grille is shaped like a spherical cap;

- the vessel is cylindrical in shape, said convex portion being formed by a half-cylinder defined longitudinally on the vessel, and the grille is shaped like a gutter;

- the grille essentially comprises a self-supporting plate pierced by multiple communicating apertures;

- the apertures are bridged holes;

- the apertures are holes made in the plate, some of which are recessed;

- the portions of the projecting plate associated with the apertures are facing towards the active material contained in the vessel;

- the plate is covered with a metallic lattice on the active-material side;

- the periphery of the grille is accommodated in a metallic section welded to the inside wall of the vessel;

- the vessel is an adsorption vessel, the bottom of which is convex and the grille is a supporting grille for an adsorption material in particle form contained in the vessel;

- a layer of a diffusion material, particularly of ceramic beads, is provided, arranged between the grille and the active material.

The subject-matter of the invention is also a vessel having a convex portion which delimits an internal space of the vessel, particularly a convex bottom, and containing an active material retained, on the side of this convex portion, by a grille arranged as defined above.

The invention will be better understood by reading the following description, given purely by way of example, and made with reference to the drawings, in which:

- Figure 1 is a longitudinal-section view of an adsorber equipped with a retaining grille arranged according to the invention;

- Figure 2 is a cut-away view from above of the adsorber in Figure 1, the adsorbent materials having been removed;

- Figure 3 is a larger-scale view of a detail from Figure 1, showing the joint between the grille and the bottom of the adsorber;

- Figure 4 is a perspective view of a portion of plate forming the grille, according to a first embodiment;

- Figure 5 is a plan view of a portion of plate forming the grille, according to a second embodiment of the latter;

- Figure 6 is a sectional view of the plate in Figure 5, along the line VI-VI;

- Figure 7 is a view, partly in elevation and partly in longitudinal section, of a grille arranged in the bottom of an adsorber according the invention, associated with a deflector forming a support according to a first embodiment;

- Figure 8 is a perspective view of the deflector in Figure 7;

- Figure 9 is a sectional view of the deflector in Figure 7, along the line IX-IX;

- Figure 10 is a partial longitudinal-section view of a grille arranged in the bottom of an adsorber according to the invention, associated with a deflector forming a support according to a second embodiment;

- Figure 11 is a perspective view of the deflector in Figure 10;

- Figure 12 is a perspective view of a cylindrical adsorber with a horizontal axis, equipped with a grille arranged in accordance with the invention; and

- Figure 13 is a cross-sectional view of the adsorber in Figure 12.

Figure 1 represents an adsorption vessel 10 having, in a conventional manner, a cylindrical barrel 12 with a vertical axis X-X, formed by the assembly of superimposed elementary barrels, a convex hemispherical bottom 14 and a convex hemispherical top 16. In this example, the diameter of the barrel is 3 m, but it could be considerably greater than this value.

The adsorber 10 has a feed pipe 18 for the gas being treated, connected to the hemispherical bottom 14 via a perforation 20 discharging at the pole of the hemisphere along the axis X-X.

The top 16 is equipped with a side outlet 22 for the evacuation of the treated gas, and also a safety valve 24 arranged at the summit of the top.

A self-supporting grille 26 for supporting and retaining an adsorbent material placed in the adsorber 10 above the grille is arranged inside the space delimited by the bottom 14, below the equatorial section 28 thereof and forming a link between the bottom 14 and the cylindrical barrel 12.

As can be seen in Figure 2, the grille 26 is formed by a spherical cap having a radius of curvature of approximately 2.5 metres and forming a vault, the convex side of which is uppermost. Along its circular periphery 30, this grille rests on the inside wall of the bottom. The diameter of the circular periphery 30 is equal to the radius

of curvature of the spherical cap. Thus the grille 26 extends between the lower third and half of the bottom 14.

The grille 26 is formed, for example, by perforated and dished stainless-steel plate, while the bottom 14 of the adsorber is formed from carbon-steel plates. Thus, in order to fix the grille 26 to the bottom, the periphery 30 of the same is accommodated (Figure 3) in a groove 32 in a carbon-steel torus formed from a profile bent into a ring. The torus 36 is welded in a conventional manner to the inside wall of the bottom 14, while the grille 26 is welded to the torus 36 after possible heat-treatment of the latter and of the bottom 14, these being already assembled.

The grille may also possibly be welded directly to the bottom.

The grille 26 is completely covered with a first layer 38 of large-diameter ceramic beads forming a gas diffuser, on the flat surface of which lies a second layer 40 of ceramic beads of smaller diameter, of uniform thickness, likewise intended for gas diffusion. These two layers are accommodated inside the hemispherical bottom 14, below the equatorial line 28. Above these two layers, the upper portion of the bottom 14, as well as the cylindrical barrel 12, are filled with an appropriate adsorbent material 42 in particle form. Filling is carried out up to the level of the gas-evacuation outlet 22.

Figure 4 represents an example of a plate 44 suitable for producing the grille 26 according to a first embodiment. This plate is furnished with apertures 46 formed by bridged holes 47 of rectangular shape.

These bridged holes comprise a slot 48 of rectangular shape, above which there extends a rectangular tongue 50 connected to the main surface 52 of the plate by two opposite supports 54. The tongue 50 and the supports 54 thus form a bridge over the slot 48.

Such bridged holes 47 are produced from a plate in which two parallel cuts are made for each bridged hole. The portion between these two cuts is then pushed through by a stamping tool beyond the main surface 52 of the plate, to form a bridge consisting of the tongue 50 and the two supports 54, offset directly above the slot 48 thus formed.

In an advantageous manner, the holes are grouped in lines, the holes of two adjacent lines being staggered in relation to the others.

According to a second embodiment, the grille 26 can have recessed holes, as represented in Figures 5 and 6.

The apertures in the plate are then formed by a matrix of holes consisting of circular holes 56 of large diameter, alternating with holes 58 of a smaller diameter. These holes can be made by punching.

The larger diameter holes 56 are recessed by stamping their periphery with a tool having an appropriate shape generated by revolution. Thus, as represented in Figure 6, the holes of larger diameter are in a plane offset in relation to the main plane of the plate comprising the holes of smaller diameter 58.

The apertures made in the grille 26 are preferably executed after the grille has been given a vaulted shape by stamping.

In an advantageous manner, regardless of the nature of the apertures with which the grille 26 is furnished, it is covered on its face facing towards the adsorbent material by a metallic lattice 60 represented in Figure 6. This metallic lattice 60 has a fine mesh, the diameter of the mesh being less than the diameter of a ceramic bead of the first layer 38. The lattice 60 is attached to the grille 26 by rivetting.

The plate equipped with bridged holes (Figure 4) or recessed holes (Figures 5 and 6) is facing in such a way that the projecting portions of same, associated with the apertures, namely the bridges or recessed holes, are facing towards the adsorbent

material 42, in order to form micro-deflectors. Note should also be taken of the very small area of contact between the grille and the elements it supports, which avoids practically any dead space above the grille.

Figure 7 represents a particular arrangement of the grille 26 inside the bottom 14 of the adsorber 10, of which only part of the barrel 12 has been represented.

A deflector 61, represented in detail in Figures 8 and 9, is welded to the pole of the hemisphere forming the bottom 14 and projects either side of the latter, thus constituting outside the vessel a perforation 62 suitable, for example, to take a flange (not shown) or to constitute a welding portion of an additional pipe, as represented in Figure 1.

The deflector 61 is formed from a tubular section 63, one end of which, suitable for taking the flange, has a cross-section which decreases progressively towards the outside. Slits 64 are made in the side wall for the dispersion of fluid. These slits are arranged parallel to each other, following the generating lines of the tubular section. They are spaced at regular intervals round the entire circumference of the wall of the deflector and are, in this example, eight in number.

Between them, on the side wall of the tube, the slits 64 define pillars 66 supporting the central portion of the grille 26.

An anti-splash disc 68, provided with a matrix of holes 70 and forming a grille, is arranged transversely to the inside of the tube 63. The anti-splash disc 68 is welded to the inside walls of the pillars 66, approximately at half the height of the latter.

As represented in Figure 7, the deflector 61 is welded to the bottom 14, just below the slits 64, so that the grille 26 rests supported on the upper end of the supporting pillars 66.

This annular-shaped support is particularly suitable for cooperating with the grille surface of spherical-cap shape.

Figures 10 and 11 represent another embodiment of a deflector designed to support the grille 26.

The deflector 72, represented in greater detail in Figure 11, and arranged in line with a tubular perforation 73, comprises two approximately trapezoidal plates 74 and 76, forming two panels intersecting orthogonally and connected together at a common height, thereby delimiting the space into four equal angular sectors. The minor and major bases of the trapezoidal panels 74 and 76 are slightly curved towards the outside and have profiles similar to those of the inside wall of the bottom 14 and grille 26, respectively.

An anti-splash disc 78 is arranged orthogonally in relation to the panels 74 and 76, approximately at half the height of the latter. It has holes 80 regularly distributed over the entire surface and has a diameter greater than the width of the panels 74 and 76 measured at the fixing height of the disc. Circular openings 82 are made in each of the panels 74 and 76 below the anti-splash disc 78, i.e. in the widest part of the panels.

As represented in Figure 10, the deflector 72 is arranged between the bottom 14 and the grille 26. Thus the major bases of the panels 74 and 76 rest on and are welded to the bottom 14, astride the perforation 73, while the minor bases of these panels form lines of support for the central portion of the grille 26. The grille 26 is welded to the panels 74 and 76 over the entire length of their minor bases. Under these conditions, the anti-splash disc 78 extends transversely to the direction of circulation of the fluid issuing from the perforation 73.

Figure 12 represents another embodiment of a grille for retaining an active material, arranged in accordance with the invention.

In this diagram an adsorber 100 can be seen, having a cylindrical envelope 102 formed from a tubular section, the axis of which is arranged horizontally and both ends of which are closed off by rounded side-walls 104 and 106. A pipe 108, forming a feed perforation for the gas being treated, discharges into the lower

portion of the adsorber, constituting a bottom of convex shape, formed by the lower half-cylinder. An evacuation pipe 110, diametrically opposite the pipe 108, discharges into the upper portion.

A vault-shaped retaining grille 112, also represented in Figure 13 and having the general shape of an inverted channel or gutter, the U-shaped cross-section of which is an arc of a circle, is arranged above the pipe 108 in the bottom of the vessel, over the entire length thereof. The grille has its generating lines parallel to those of the cylinder forming the vessel and its convexity facing upwards. It is connected in a leaktight manner over its entire periphery to the envelope 102 and to the rounded side-walls 104 and 106.

According to different embodiments, the grille 112 can have apertures such as those described in relation to Figures 4 and 5.

As in the preceding embodiment, the vault-shaped grille 112 is covered with a metallic lattice, which is not shown. Above this lattice, inside the vessel, are successively arranged (Figure 13) at least one first layer 114 of ceramic beads, and a second layer 116 of adsorbent material.

It may be understood that the use of a supporting grille for adsorbent, having a vaulted shape and facing so that the direction of convexity is opposite to that of the bottom on which it is resting, permits a great saving of space in the vessel. In fact, whereas known flat grilles have to be arranged in the equatorial plane of the bottom in the case of a vessel with a vertical axis and hemispherical bottom, or at the level of the greatest cross-section in the case of a horizontal cylindrical adsorber, a vault-shaped grille arranged as described above enables a large space to be obtained inside the bottom proper, above the grille. As shown in Figure 1, this space is suitable for accommodating, for example, the diffusing material, as well as a certain thickness of adsorbent material. Thus, the supported materials are accommodated in the bottom proper of the adsorber, whereas, in known absorbers, they are placed in the barrel 12. The result of this is that, for a given total quantity of adsorbent material, the adsorbers can have a reduced total volume, the reduction in volume

corresponding to the space gained in the bottom by using a grille arranged according to the invention.

This gain in space is, moreover, rendered possible by the vaulted shape of the grille, which permits a better diffusion of gas over the entire width of the vessel. Under these conditions, it is possible to position the grille particularly low down inside said vessel.

In addition, the rounded shape of the grille permits an optimal reduction of the volume of ceramic beads that have to be used to obtain good diffusion of the gas. Indeed, these beads are most useful at the periphery of the supporting grilles, i.e. in an eccentric position in relation to the feed-pipe outlet. The particular vaulted shape of the grille permits a reduction of the quantity of ceramic beads in the central portion, where they are less indispensable, while the quantity of beads present at the periphery of the grille is kept large.

The reduction of the dimensions of the grille and its self-supporting nature also permit a reduction or elimination of the supporting structures for the grille, hence a major saving in the associated manufacturing costs.

The invention as just described can, of course, apply to bottoms of a different shape, for example having an elliptical or parabolic cross-section, or indeed to any bottom delimited by any surface of revolution whatever. Moreover, it applies to any convex portion of the vessel, other than the bottom: the top, for example.

In addition, such an arrangement can be used to cover not only a fluid inlet or outlet, as previously described, but also a temperature sensor, pressure sensor, etc., of a manhole or any other individual portion of the vessel.

Moreover, it is understood that the use of a deflector arranged as described in relation to Figures 7 to 11, and which is designed to ensure both a good distribution of gas at the outlet of the feed pipe and the support of the retaining grille for the

active material, results in reduced manufacturing costs, since it enables a specific supporting structure for the grille to be dispensed with.

Moreover, the use of such a deflector which is responsible for supporting the grille permits a reduction of the thickness of the grille and thus a corresponding reduction of the cost of manufacture. Such a deflector likewise permits a grille with a larger span to be used.

CLAIMS:

1. A fluid-processing vessel comprising a casing having a bottom portion and containing at least one active material arranged inside an internal space delimited, in its lower portion, by a grille structure supported inside the casing, wherein the vessel is elongated in shape, the bottom portion being convex and being substantially semicylindrical in shape, the grille structure bearing at least at its periphery on the inner wall of the bottom portion.

2. A vessel according to claim 1, wherein the grille structure is convex, the directions of convexity of the grille structure and of the bottom portion being opposite.

3. A vessel according to claim 2, which comprises at least one layer of diffusion material arranged over the convex grille structure and having a substantially plane upper surface supporting the active material.

4. A vessel according to claim 3, wherein the diffusion material comprises ceramic beads.

5. A vessel according to any preceding claim wherein the active material comprises particles of at least one adsorbent material.

6. A vessel according to any preceding claim, wherein the grille essentially comprises a self-supporting plate pierced by multiple communicating apertures.

7. A vessel according to claim 6, wherein the apertures are bridged holes.

8. A vessel according to claim 6, wherein the apertures are holes made in the plate, some of which are recessed.

9. A vessel according to claim 7 or claim 8, wherein the portions of the projecting plate associated with the apertures are facing towards the active material contained in the vessel.

10. A vessel according to claim 6, wherein the plate is covered with a metallic lattice on the active-material side.

11. A vessel according to any preceding claim, wherein the periphery of the grille is accommodated in a metallic section welded to the inside wall of the vessel.

The Patent Office

INVESTOR IN PEOPLE

Application No: GB 9826990.5
Claims searched: 1-11

Examiner: J.H.Warren
Date of search: 22 January 1999

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.Q): B1F (F4E, FD1C, FCAB, FCBA) ; B1L (LDD)

Int Cl (Ed.6): B01J 8/00, 8/02, 8/44; B01D 53/04

Other: EPODOC

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2 027 608 A	UOP - see apertured plate 26	1
X	GB 1 561 148	ATLANTIC RICHFIELD - see Figure 8, grill 60	1
X	GB 1 250 962	SIMON-CARVES - see Figure 5, also page 2 lines 89-95	1,4
X	GB 1 081 748	HYDROCARBON RESEARCH - see grill 4	1
X	US 4 298 589	KELLOGG - see grid 46 in Figure 1 and grid 116 in Figure 2	1

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.